REMARKS

Objections to the Claims

The Examiner objected to Claims 31, 33, 34-37, 40, 42, 44, and 46-47 because he concluded that those claims contain certain informalities. The Examiner identified alleged informalities in Claims 34, 35, 36, and 47. Claims 34, 35, 36, and 47 have been amended in accordance with the Examiner's suggestions. However, the Examiner did not identify any informalities in Claims 31, 33, 37, 40, 42, 44, and 46. Therefore, none of those claims have been amended in response to the objection at this time. If the Examiner intends to maintain the objection to Claims 31, 33, 37, 40, 42, 44, and 46 in the next action on this application, then it is respectfully requested that he identify the alleged informalities so that the Applicant can make any necessary amendments to correct the alleged informalities.

35 USC 112, Second Paragraph: Claims 31, 33, 37-40 42, 44, and 46-49

The Examiner rejected Claims 31, 33, 37-40, 42, 44, and 46-49 under 35 USC 112, second paragraph, as being too indefinite. In general, the Examiner pointed out instances in the rejected claims where there was no antecedent basis for a claimed element or feature that was preceded by the definite article "the". It is believed that the amendments to Claims 30, 31, 32, 37, 39, 41, 42, 44, and 46 overcome this rejection. Therefore, the rejection should be withdrawn.

35 USC 103(a): Claims 41 and 42

The Examiner rejected Claims 41 and 42 under 35 USC 103(a) as being unpatentable over US 6,904,079 (Hoffmann et al.) in view of US 2002/0173341 (Abdelmonem et al.) and US 2001/0033625 (Ninominya et al.).

Claim 41

Regarding Claim 41, the Examiner asserted that Hoffmann et al. discloses a receiver comprising a correlator arranged to detect pilot symbols in the data. Claim 41 of the present application claims a "narrowband interference reducing system for a receiver comprising... a

correlator arranged to detect pilot symbols in the filtered data... ." Claim 41 is directed to a narrowband interference reducing system. The filtered data referred to in Claim 41 is received data that has been filtered to filter out narrowband interference.

Hoffmann et al. is concerned with implementing pilot symbol signals on a reverse link in a wireless communication system. In Hoffmann et al., pilot symbol detection uses matched filters only (see Figures 4 and 5). Narrowband interference does not degrade performance of pilot symbol detection that uses matched filters only. Therefore in Hoffmann et al., there is no problem with narrowband interference and Hoffmann et al. does not describe a narrowband interference reducing system.

In the Applicant's claimed system as set forth in Claim 41, the pilot symbol detection comprises a combination of a sliding window correlator and a matched filter correlator. Narrowband interference degrades performance of pilot symbol detection employing the sliding window correlator. Because the performance of the pilot symbol detector in Hoffmann et al. is not affected by narrowband interference, and Hoffmann et al. does not describe a narrowband interference reducing system, the Applicant submits that Hoffmann et al. is not a relevant citation to Claim 41. Further, even if Hoffmann et al. can be considered relevant to a narrowband interference reducing system, there is no motivation to combine Hoffmann et al. with the other documents because Hoffmann et al. is not affected by narrowband interference.

The Examiner asserts that Ninominya discloses a logic system arranged to reroute the received data to a receiving apparatus when a pilot symbol has been detected.

In the Applicant's claimed system, the receiver receives data packets of one type of modulation only then switches out a processing element (N-LMS filter) for every received packet after pilot symbol detection where decisions are made 1) whether a valid packet has been received and 2) at which temporal sample the pilot symbol ceases. The second decision is required to prevent the processing element from introducing interference into the demodulator.

In Ninominya, a continuous data stream is received from any one of several modulations. The received data is routed to the appropriate modulator when decisions are made 1) whether a continuous time carrier has been detected and 2) which modulation type was employed at the transmitter. The second decision is required to enable the receiver to modulate a number of different types of signals. Applicant submits that Ninominya does not describe the logic system arranged to re-route the received data to a receiving apparatus when a pilot symbol has been detected because Ninominya re-routes the data to one of two receiving apparatuses depending not only on when a pilot symbol has been detected, but also on what type of modulation has been detected. Ninominya would not work if the logic system re-routed the received data to the same receiving apparatus whenever a pilot symbol was detected because this would not allow Ninominya to demodulate different types of signals.

The aim of Ninominya is to demodulate different types of signals. The Applicant therefore submits that Ninominya does not describe a logic system arranged to re-route received data to a receiving apparatus when a pilot symbol has been detected. Further, Ninominya is not part of a narrowband interference reducing system for a receiver.

The Examiner asserts that Abdelmonem et al. describes a front end arranged to receive data and an adaptive filter arranged to filter narrowband interference from the received data and provide filtered data.

In the Applicant's claimed system, an N-LMS adaptive filter is used that removes all signal components which are cyclostationary with period K. Both narrowband signals and (wideband) OFDM packets exhibit this property. This leads to the requirement to remove the N-LMS filter from the signal chain upon detection of the pilot symbol. In the Applicant's claimed system, no attempt is made to estimate any of the spectral location, bandwidth, power, or even existence of narrowband interferers.

Abdelmonem et al. employs a bank of one or more non-adaptive notch filters that are inserted into the receiver chain after estimation of several interference parameters including carrier frequency and bandwidth. These parameters are used to select which predefined notch filter(s) should be inserted. See for example the description in paragraph 0118 and onwards.

The Examiner asserts that it would have been obvious to one skilled in the art at the time of the invention to employ the teachings of Abdelmonem et al. in the receiver of Hoffmann et al. and Ninominya to reduce interference and improve integrity of the received wideband signal. The Applicant submits this conclusion is not correct because: a) Hoffmann et al. does not describe or suggest any problem of narrowband interference, b) it cannot be obvious to employ a system for filtering narrowband interference into a receiver that does not experience narrowband interference, and c) Ninominya introduces a system for switching different parts of a receiver in such that one receiver can receive signals that have been modulated using different modulation schemes.

In attempting to combine Ninominya and Hoffmann et al., the Examiner is attempting to solve a problem that is neither described nor suggested in Hoffmann et al. If the problem to which the Applicant's claimed system is directed was not known or obvious to one skilled in the art, then the solution therefor cannot be obvious.

For all of the foregoing reasons, it is believed that the proposed combination of Hoffmann et al., Abdelmonem et al., and Ninominya et al. fails to present a *prima facie* case of unpatentability relative to Claim 41 because those references, considered alone or in combination, do not provide substantial evidence of unpatentability of the subject matter of Claim 41. Therefore, the rejection should be withdrawn.

Claim 42

The Examiner states that although none of Hoffmann et al., Ninominya, and Abdelmonem et al. specifically disclose that the number of taps in the adaptive filter is greater than the maximum number of interferers to be cancelled these limitations are merely a matter of design choice. The Examiner states that the design choice would have been obvious to the reader of Hoffmann et al., Ninominya, and Abdelmonem et al.

However, Abdelmonem et al. is the only cited document that describes using an adaptive notch filter. The adaptive notch filter in Abdelmonem et al. is a bank of one or more non-adaptive notch filters which are inserted into the receiver chain. The Applicant refers the Examiner to paragraph 0107 of Abdelmonem et al. which describes using a single notch filter and paragraph 0119 which describes using two or more notch filters. As described in those paragraphs, the number of narrowband interferers that can be removed is determined by the number of notch filters employed. However, that has nothing to do with the number of taps in each filter.

The Applicant submits that it would not have been obvious in view of Abdelmonem et al. to provide an adaptive filter wherein the number of taps of the single adaptive filter is greater than the number of interferers to be cancelled. Abdelmonem et al. provides a solution to the problem of cancelling more than one interferer and that solution is different from the one provided by the Applicant's claimed system as set forth in Claim 42.

For all of the foregoing reasons, it is believed that the proposed combination of net al., Abdelmonem et al., and Ninominya et al. fails to present a *prima facie* case of unpatentability relative to Claim 42 because those references, considered alone or in combination, do not provide substantial evidence of unpatentability of the subject matter of Claim 42. Therefore, the rejection should be withdrawn.

35 USC 103(a): Claim 43

The Examiner rejected Claim 43 under 35 USC 103(a) as being unpatentable over Hoffmann et al., Abdelmonem et al., and Ninominya, and further in view of US 2002/0196876 (Takada).

Claim 43 includes the feature that the adaptive filter uses a delayed stream of received data as a reference signal. The adaptive filter used in the Applicant's claimed system is an N-LMS adaptive filter that employs a reference stream to effect subtractive cancellation in which the cyclostationary (interference) component is removed from the input data stream through subtraction.

In Abdelmonem et al. (as shown in Figure 10), a bank of one or more non-adaptive notch filters are inserted into the receiver chain to remove interference. Notch filters employ multiplicative cancellation which attenuates all signal components by the filter transfer function. Multiplicative cancellation does not require the use of a reference stream. It is not practically possible to combine the notch filters of Abdelmonem et al. and the adaptive filter of Takada to any useful end. The two filters work on different principals and are not readily combined.

For all of the foregoing reasons, it is believed that the proposed combination of Hoffmann et al., Abdelmonem et al., Ninominya et al., and Takada fails to present a *prima facie* case of unpatentability relative to Claim 43 because those references, considered alone or in combination, do not provide substantial evidence of unpatentability of the subject matter of Claim 43. Therefore, the rejection should be withdrawn.

35 USC 103(a): Claim 44

The Examiner rejected Claim 44 under 35 USC 103(a) as being unpatentable over Hoffmann et al., Abdelmonem et al., and Ninominya and in further view of US 2004/0198452 (Roy). In making this rejection the Examiner stated that Roy discloses an adaptive filter comprising a tapped-delay line having taps spaced by a symbol period. The Examiner also stated

that it would have been obvious that a symbol period would be longer than the pilot period.

In the Applicant's claimed system as set forth in Claim 44 a reference stream is obtained by delaying the input stream for a period "longer than" the length of the pilot symbol. This delay length is independent of the symbol period and the delay is inserted to ensure that the reference stream contains no pilot symbol which would degrade performance of the adaptive filter.

In contrast, Roy uses a symbol space or fractional symbol space (see paragraph 0023) taps in an equalizer. Thus, Roy requires that the sample period be "less than or equal to" the symbol period to prevent aliasing in the sampled signal. Roy does not disclose a delay in the stream of received data entering the adaptive filter.

For all of the foregoing reasons, it is believed that the proposed combination of Hoffmann et al., Abdelmonem et al., Ninominya et al., and Roy fails to present a *prima facie* case of unpatentability relative to Claim 44 because those references, considered alone or in combination, do not provide substantial evidence of unpatentability of the subject matter of Claim 44. Therefore, the rejection should be withdrawn.

35 USC 103(a): Claim 45

The Examiner rejected Claim 45 under 35 USC 103(a) as being unpatentable over Hoffmann et al., Abdelmonem et al., and Ninominya as applied to Claim 41 and further in view of US 6,807,224 (Takahashi et al.). In making this rejection, the Examiner stated that the combination of Hoffmann et al., Abdelmonem et al., and Ninominya does not include a matched filter correlator. However, the Examiner asserted that Takahashi et al. describes a receiver having a sliding correlator and a matched filter. The Examiner then concluded it would have been desirable to include a matched filter correlator in the Hoffmann-Abdelmonem-Ninominya combination so that current consumption could be reduced by using the matched filter occasionally.

The Examiner states that it would be obvious to any one with ordinary skill in the art at the time of the invention to employ the teaching of Takahashi et al. to improve power efficiency in the receiver that would be represented by combining Hoffmann et al., Abdelmonem et al., and Ninominya. However, the matched filter described in Takahashi et al. is not used to improve power efficiency, but rather is used to perform a correlation between the received signal and a scrambling code. The signals received in the Takahashi et al. device have been scrambled using a scrambling code and the matched filter is used to determine which of the scrambling codes has been applied to the received signal. None of the other documents cited by the Examiner uses scrambling codes. The Applicant therefore, submits that it would not have been obvious to incorporate a matched filter as described in Takahashi et al. that correlates scrambling codes to a system that has no scrambling codes.

Moreover, the Applicant's claimed system as set forth in Claim 45 does not use a matched filter to improve power efficiency. The only reference to power efficiency is that made up by the Examiner in the Official Action.

For all of the foregoing reasons, it is believed that the proposed combination of Hoffmann et al., Abdelmonem et al., Ninominya et al., and Takahashi et al. fails to present a *prima facie* case of unpatentability relative to Claim 45 because those references, considered alone or in combination, do not provide substantial evidence of unpatentability of the subject matter of Claim 45. Therefore, the rejection should be withdrawn.

35 USC 103(a): Claims 30 and 31

The Examiner rejected Claims 30 and 31 under 35 USC 103(a) as being unpatentable over Abdelmonem et al. in view of US 2002/0094020 (Yellin) and Hoffmann et al.

Claim 30

In explaining the rejection of Claim 31 the Examiner indicated that it would have been obvious to combine the teaching of Yellin and the method of Abdelmonem et al. and Hoffmann et al. to reduce the power consumption of the adaptive filter.

In the Applicant's claimed method, the sliding window correlator is used as the primary detection method due to very low computational complexity of the detector. However, this type of detector is vulnerable to false detection in the presence of narrowband interference (see the description and equations 7-11) requiring the use of an efficient adaptive filter, such as N-LMS filter. The N-LMS filter achieves design goals of maintaining computational efficiency while mitigating the effects of narrowband interference (see for example Table 1 and examples 1-6 of the present application).

The system described in Abdelmonem et al. employs a sequence of notch filters requiring one for each interferer (see paragraph 0119 of Abdelmonem et al.) where the notch filters typically require many tens of taps to achieve the performance stated in paragraph 0128 (-40 dB with a bandwidth of 15 kHz). Moreover, the matched filter detector described by Hoffmann et al. (PCF/70, Figure 4) is significantly more computationally complex than a sliding window correlator.

The matched filter detector is not vulnerable to narrowband interference and therefore does not require combination with the system of Abdelmonem et al. to perform pilot symbol detection. There is no readily apparent reason to combine the inventions of Abdelmonem et al. and Hoffmann et al. Even if the two references could somehow be combined, they would not describe the invention even when combined by selecting features as the Examiner has done. A combination of Abdelmonem et al. and Hoffmann et al. would not provide a system wherein when a pilot symbol is detected as received data is passed to a receiving apparatus without first passing through an adaptive filter.

The Examiner cites Yellin as providing the feature missing from the proposed combination. However, Yellin removes pilot signal interference from a received signal in a mobile receiver (see for example paragraph 0002 of Yellin). The pilot signals referred to in Yellin are a PN code multiplied by the Walsh code transmitted by base stations to allow synchronization at mobile units and to provide the base station PN sequence (see, paragraphs 0005 and 0006 of Yellin). The pilot signals used in Yellin are wideband (paragraph 0023). Paragraph 0067 and 0068 of Yellin describe a system for removing interfering pilot signals.

Abdelmonem et al. describes switching out notch filters when no narrowband interference is present. The combination of these documents does not describe when a pilot symbol is detected passing the stream of received data to a receiving apparatus without first passing the received data through an adaptive filter.

The switch used in Abdelmonem et al. is not related to detection of pilot signals, but rather to switching out the notch filters if no narrowband interference is present. In the system of Yellin the pilot signals are always present and are distinct from the pilot symbol at the start of the received data. There is no suggestion in Yellin of switching out the pilot signal interference removal system as these pilot signals in Yellin are always being transmitted from the base stations. Further, the pilot signals are wideband and cannot be said to constitute narrowband interference. In Yellin the pilot signals must constantly be removed from the data.

The Applicant agrees that there is a switch described in Abdelmonem et al. that switches notch filters in and out. However, that is not done in any way that is dependent on whether a pilot symbol is present and Yellin does not provide such a feature or even suggest it. Yellin simply provides a receiver that removes wideband pilot signals that are continuously transmitted from base stations. Those signals are wideband signals so they are not removed by any narrowband interference adaptive filters. Also, the signals are always present, and so they must always be removed in the system of Yellin.

Finally, reduction of power consumption is not an explicit objective of the Applicant's claimed method, nor of that described in any of the cited references. The only suggestion of reducing power consumption is made by the Examiner. The Applicant submits that reducing power consumption is not a proper motive to combine the citations as the only suggestion of that motivation comes from the Examiner.

For all of the foregoing reasons, it is believed that the proposed combination of Abdelmonem et al., Yellin, and Hoffmann et al., fails to present a *prima facie* case of unpatentability relative to Claim 30 because those references, considered alone or in combination, do not provide substantial evidence of unpatentability of the subject matter of Claim 30. Therefore, the rejection should be withdrawn.

Claim 31

With regard to Claim 31, the Examiner stated that the number of taps used in the adaptive filter is merely a matter of design choice and would have been obvious in the receiver resulting from the proposed combination of Abdelmonem et al., Yellin, and Hoffmann et al. However, the only filters described in any of those citations are the notch filters of Abdelmonem et al. (which are not adaptive filters). Those filters have many tens of taps and the number of filters used in the system described in Abdelmonem et al. must be greater than the number of interferers to be cancelled. In Abdelmonem et al., each filter is used for one interferer to be cancelled independently of the number of taps in each notch filter. The number of taps on each filter in Abdelmonem et al. is related to filter performance and not to the number of interferers to be cancelled.

Accordingly, the Applicant submits that it would not have been obvious from the Examiner's combination of Abdelmonem et al., Yellin, and Hoffmann et al. to conclude that the number of taps in the adaptive filter is an obvious design choice.

For all of the foregoing reasons, it is believed that the proposed combination of Abdelmonem et al., Yellin, and Hoffmann et al., fails to present a *prima facie* case of unpatentability relative to Claim 31 because those references, considered alone or in combination, do not provide substantial evidence of unpatentability of the subject matter of Claim 31. Therefore, the rejection should be withdrawn.

35 USC 103(a): Claim 32

The Examiner rejected Claim 32 under 35 USC 103(a) as being unpatentable over Abdelmonem et al. in view of Yellin and Hoffmann et al., and further in view of Takada. In making this rejection the Examiner stated that Takada provides an adapter filter that uses a delayed stream of the received data as a reference signal. The Examiner asserted that it would be desirable to use a delayed stream of the received data as a reference signal because it provides the benefit of efficient interference removal in case an interference signal is superimposed on a desired signal.

The adaptive filter used in the Applicant's claimed method as set forth in Claim 32 is an N-LMS adapter filter that employs a reference stream to effect substantive cancellation of which the cyclostationary (interference) component is removed from the input data through subtraction.

In contrast, Abdelmonem et al. (Figure 10), shows and describes a bank of one or more non-adaptive notch filters are inserted into the receive chain to remove interference. Notch filters employ multiplicative cancellation which attenuates all signal components by the filter transfer function. Multiplicative cancellation does not require the use of a reference stream. It is not possible to combine the notch filters of Abdelmonem et al. with the adaptive filter of Takada to any useful purpose. The two filters work on different principals and cannot be readily combined. Thus, the Applicant submits that it would not have been obvious to combine Takada with Abdelmonem et al., Yellin and Hoffmann et al. as the filters of Takada and Abdelmonem et al. cannot be readily combined.

For all of the foregoing reasons, it is believed that the proposed combination of Abdelmonem et al., Yellin, Hoffmann et al., and Takada fails to present a *prima facie* case of unpatentability relative to Claim 32 because those references, considered alone or in combination, do not provide substantial evidence of unpatentability of the subject matter of Claim 32. Therefore, the rejection should be withdrawn.

35 USC 103(a): Claim 33

The Examiner rejected Claim 33 under 35 USC 103(a) as being unpatentable over Abdelmonem et al. in view of Yellin, Takada, and Hoffmann et al., as applied to Claim 32 and further in view of Roy. The Examiner stated that Abdelmonem et al., Yellin, Hoffmann et al., and Takada disclose all the subject matter of Claim 33 except a length of a delay in a delayed stream of data that is longer than the length of the pilot signal.

The Examiner went on to state that Roy discloses an adaptive filter comprising a tapped-delay line having taps spaced by a symbol period. The Examiner also stated that it would have been obvious that a symbol period would be longer than the pilot period. In the Applicant's claimed method as set forth in Claim 33, a reference stream is obtained by delaying the input stream for a period longer than the length of the pilot symbol. This delay length is independent of the symbol period and the delay is inserted to ensure that the reference stream contains no pilot symbol which would degrade performance of the adaptive filter.

In contrast, Roy uses a symbol space or fractional symbol space taps in an equalizer (see paragraph 0023 of Roy) taps in an equalizer. In the system described in Roy, the requirement is that the sample period be 'less than or equal to' the symbol period to prevent aliasing in the sampled signal. Roy does not disclose a delay in the stream of received data entering the adaptive filter.

For all of the foregoing reasons, it is believed that the proposed combination of Abdelmonem et al., Yellin, Takada, Hoffmann et al., and Roy fails to present a *prima facie* case

of unpatentability relative to Claim 33 because those references, considered alone or in combination, do not provide substantial evidence of unpatentability of the subject matter of Claim 33. Therefore, the rejection should be withdrawn.

CONCLUSION

In view of the foregoing amendments and remarks, it is believed that all of the pending claims are in condition for allowance. The Applicant respectfully requests that the Examiner reconsider the rejection of the application.

Respectfully submitted,

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